



Effectiveness of Stretching Exercise in the Treatment of Plantar Fasciitis-A Review of Literature

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Abstract

Plantar fasciitis is one of the most common cause of heel pain it is a Common musculoskeletal foot disorder involving pain and gait problems. It mainly occurs during the middle age of 40 and 60 years in general population with prevalence of 11-15% [3]. The causes of this disease is not clear but the most common theory say that it is due to repetitive micro trauma and chronic inflammation of the plantar fascia inserted on the medial tubercle of the calcaneus.

The major contributing factors related to plantar fasciitis are Obesity, biomechanics of foot disturbances, poor foot wear, work related activity and over exertion.

Overuse activity is the most common cause of injury such as running and jobs with prolong standing this will increases risk of micro trauma of the fascia. The normal presentation of plantar fasciitis includes gradual, insidious onset of inferior-medial heel pain of the insertion of the plantar fascia worse with rising morning or after prolonged weight bearing activities and exacerbated by climbing stairs or doing toes raises.

Keywords: Planter Fasciitis, Obesity; Heel Pain; Weight Bearing Activity; Chronic Inflammation; Gait

Abbreviations

PF: Planter fasciitis

Introduction

Plantar fasciitis is one of the most common cause of heel pain [1] it is a Common musculoskeletal foot disorder involving pain and gait problems [2]. It mainly occurs during the middle age of 40 and 60 years in general population with prevalence of 11-15% [3]. The etiology of this disease is not clear but the most common theory is repetitive micro trauma and chronic inflammation of the plantar

fascia inserted on the medial tubercle of the calcaneus [4]. The major contributing factors related to plantar fasciitis are Obesity, biomechanics of foot disturbances, poor foot wear, work related activity and over exertion. Overuse is the most common cause of injury such as running and jobs with prolong standing increases risk of micro trauma of the fascia [5]. The classical presentation of plantar fasciitis includes gradual, insidious onset of inferior-medial heel pain of the insertion of the plantar fascia worse with rising morning or after prolonged weight bearing activities and exacerbated by climbing stairs or doing toes raises. Diagnosis of

plantar fasciitis based on patients history, clinical symptoms, foot questionnaires and objective assessment such as pain score, palpation, muscle tightness, joints ROM, muscle strength [2].

Windlass mechanism

Hicks described the foot and its ligaments as an arch –like triangular or truss. Truss is formed by the plantar fascia and longitudinal arch of the foot (calcaneus, midtarsal joint and metatarsal). The plantar fascia formed the tie-rod that ran from the calcaneus to the phalanges [6]. A “Windlass” is the tightening of a rope or cable. The plantar fascia stimulates a cable that attached to the calcaneus and the metatarsophalangeal joints. Dorsiflexion of the toes during the late stance phase of gait winds the plantar fascia around the metatarsal heads. This winding of the plantar fascia shortens the distance between the calcaneus and metatarsals that elevates and reinforces medial longitudinal arch of the foot, this effects is called “Windlass” mechanism [6,7].

Need of study

- In day to day life chronic plantar fasciitis is very common condition seen in the physiotherapy OPD.
- To know the problem of people due chronic plantar fasciitis in the activities daily living and to reduce the pain and improve functional independence by using therapeutic stretching exercise.
- To evaluate the effectiveness of stretching exercise in patients with plantar fasciitis

Aim and Objectives

Aim

Evaluate the effects of stretching exercise in the treatment of plantar fasciitis.

Objective

- To assess the evidence for effectiveness of therapeutic stretching exercise for plantar fasciitis.
- To quantify the effect of stretching exercise on reduction of pain, disability and improve ADL in chronic plantar fasciitis.

Methodology

Study design: Review of literature.

Inclusion criteria

Last 10 years full text articles, English language articles, Both Unilateral and Bilateral plantar fasciitis, ages 18 to 70 years, weight bearing and non-weight bearing stretching exercise

Exclusion criteria

Articles which involves different language, Any Electrical modalities, age less than 18 years, corticosteroid injection, and plantar heel pain lasting more than a year.

Review of Literature

Engkananuwat P, *et al.* (2018) did a study entitled “Effectiveness of the simultaneously stretching of the Achilles tendon and plantar fascia in individual with plantar Fasciitis”. The study included 50 participants recruited by convenience sampling which was randomly assigned into Group 1 and Group 2. Treatment intervention for group 1 is stretching of Achilles tendon and group 2 is simultaneously stretching of Achilles tendon and plantar fascia. Treatment protocol for both groups was similar 5 sets of a 20 sec stretch, 20 second rest twice a day for 5 days per week for 4 weeks. The inclusion criteria for the participants were plantar heel pain for at least 1 month, tenderness on Palpation of the medial plantar Calcaneal region, pain on the first step in the morning. The exclusion criteria were diabetes mellitus, a history of fracture of the lower extremities, prior corticosteroid injection, rheumatoid arthritis, serve vascular disease. The outcome measured used were VAS scale, pressure Algometer, Universal Goniometer, and VAS foot and ankle questionnaire. SPSS version 17 was used for statistical analysis. This study suggests that simultaneously stretching of the Achilles tendon and plantar Fascia for 4 weeks was a more effective intervention for plantar Fasciitis [12].

Rajendran K, *et al.* (2017) conducted a study on “Effectiveness of non-weight bearing tissue specific stretching exercise and weight bearing stretching exercise in reduction of pain and functional improvement on chronic plantar Fasciitis patients”. A comparative study selected 20 participants (7 males and 13 females) randomly allocated into Group A and Group B. The treatment intervention for Group A (4 males and 6 females) is non weight bearing tissue specific stretching exercise (plantar fascia stretching exercise) and for Group B (3 males and 7 females) is weight bearing stretching exercise(Achilles tendon). Both the group follow the same stretching treatment protocol which is 10 second of stretch, 3 sets

a day for 2 weeks. The inclusion criteria were the age between 26 to 69 years, unilateral plantar Fasciitis, had the symptoms more than 12 weeks. The exclusion criteria were any history revealed any inflammatory, osseous, metabolic or neurological abnormalities and received any corticosteroid injection within the past 3 months. VAS scale and foot functions index used as the outcome measured. To interpret the results within the group paired 't' test was used and independent 't' test used to interpret the results between the groups. This study concluded that both treatment interventions are effective relieving pain and increasing foot function among the participants with chronic plantar Fasciitis [3].

Hesham A. Mohamed, (2015) did a study entitled "Effectiveness of Achilles tendon-stretching for the treatment of chronic plantar fasciitis". Totally 24 participants included among them 14 were men and 10 were female. The Stretching program for Achilles tendon stretch was three times per day, each stretch hold for a count of 10 and to repeat it 10 times at each session for minimum of 3 months. Participants was included in this study if they had history of heel pain lasting more than 6 months, patients who reported pain and tenderness over the medial aspect of the heel/foot. Patients were excluded from the study if they had plantar heel pain lasting more than 2 years, if they had a history of systemic disease, a previous surgical release of plantar fascia, or prior heel surgery. The outcome measured used were Foot Functional Index and The American Orthopedic Foot and Ankle Society Scale. This study concludes that Achilles tendon stretching can significantly reduce global measures of pain and disability for patients with chronic plantar fasciitis [13].

Ozer, *et al.* (2015) did a study entitled "Effectiveness of Plantar Fascia-Specific Stretching Exercises in Plantar Fasciitis". 21 participants and 29 feet with the inclusion criteria mean age was 49.3 years (24-72), history of heel pain with the first step in the morning and which was decreases by walking and increases again after standing for a long time, inferior medial side of the heel was painful by palpation. The exclusion criteria were any history systemic disease, other inferior heel pain causing diseases, such as tarsal tunnel syndrome, L5-S1 radiculopathy, fat pad atrophy, calcaneal stress fracture, tumors or tumor-like lesions. All participants perform non weight bearing plantar fascia specific stretching exercises with 10 repetitions, two times a day. Silicon heel pads and non-steroidal anti-inflammatory drugs were given

to the patients. Patients were asked to follow the exercise regime regularly for 8 weeks' time. Visual analog pain scale was used as outcomes measured. The Statistical analysis was done using NCSS2007 software. For data assessment, definitive statistical methods (mean, standard deviation) were used and the Wilcoxon test for repetitive measures. The study concluded that Plantar-fascia specific stretching exercise is an effective conservative treatment option in plantar fasciitis [14].

Jha R K, *et al.* (2013) did a study on "Functional Outcome in Patients with Chronic Plantar Fasciitis Treated with Plantar Fascia Stretching vs Tendoachilles Stretching Exercises". A comparative study included 65 participants and 83 feet which was randomly assigned into Group A and Group B. Participants who were randomized to treatment Group A received instructions of plantar fascia tissue-stretching program and Group B received instructions of Tendoachilles stretching program. The inclusion criteria was Sign and symptoms of chronic plantar fasciitis for at least ten months, complained of maximum pain upon palpation of the origin of the plantar fascia on the medial calcaneal tubercle, consistent with a diagnosis of proximal plantar fasciitis. Patients were excluded if they had a history of systemic inflammatory disease, diabetes mellitus, prior heel surgery, or heel pain that is not consistent with proximal plantar fasciitis, inability or unwillingness to discontinue current treatment modalities that are used for the purpose of plantar fasciitis, Ages less than 18 years, anatomical abnormality of foot and ankle and neurological abnormality. The outcomes measured used were foot function index and visual Analog pain scale. T test were used for continuous data and an overall significance level was maintained at $p < 2.05$. This study showed that a program of non-weight bearing stretching exercises specific to the plantar fascia is superior to the standard program of weight-bearing Achilles tendon-stretching exercise for the treatment of symptoms of proximal plantar fasciitis [15].

Chakraborty M K, *et al.* (2011) did a prospective study on "Efficacy of Stretching Exercises in the Treatment of Chronic Plantar Fasciitis". A prospective interventional study enrolled 50 participants, 36 were female and 14 were male with Mean age of participants were $46.12 \pm SD7.11$ years and all had chronic pain for more than 3 months, Tenderness of the sole of the foot at the origin of the plantar fascia on the medial tubercle of calcaneal are included in this study. The exclusion criteria was patients who had a

history of systemic disease, prior heel surgeries calcaneal fracture, calcaneal nerve entrapment or heel pain that was not consistent with the diagnosis of proximal fasciitis, those who received steroid injections and those who were lost in periodic follow up. The outcomes measured used were foot function index and visual Analog pain scale. The treatment protocol for the plantar fascia stretch is hold the assigned stretch for ten seconds and to repeat it ten times, three times a day, with the first stretch done before the first step was taken in the morning for at least minimum of two months. Analysis was done using descriptive statistics and testing of hypothesis. A p-value of < 0.05 (two-tailed) was used to establish statistical significance. This study concluded that Tissue specific plantar fascia stretching exercise protocol alone can optimize tissue tension through control stretch of the plantar fascia by recreation of windlass mechanism (dorsiflexion of the first metatarsal and dorsiflexion of the ankle joint) [8].

Anand Kumar Singh, *et al.* (2017) did a study entitled "Comparison between Kinesio taping and Tissue Specific Plantar Fascia Stretching Exercise Treatment in Plantar Fasciitis". A comparative study selected 30 participants by means of convenience sampling and allocated into Group A (15) and Group B (15). Group A – Kinesio-taping and Group B- Tissue specific planter fascia stretching exercise. The inclusion criteria were chronic heel pain for at least ten months, both male and female, age between 30 to 60 years , patients complained of maximum pain upon palpation of the origin of the plantar fascia on the medial calcaneal tubercle, were enrolled in the study. The exclusion criteria was failed to respond to previous non operative treatments including non-steroidal anti-inflammatory medications, orthoses, heel cups, exercises, night splints, injections, and/or activity modifications, history of systemic disease, prior heel surgery, or heel pain that was not consistent with proximal plantar fasciitis. The outcome measured used were Numeric pain rating scale (NPRS) and foot functional index (FFI). Data was analyzed with appropriate statistical tool using the SPSS version 20.0. This study concluded that the kinesiotaping provided better relief of symptoms with better biomechanical correction in short term when compared to tissue specific plantar fascia stretching exercise in planter fasciitis [16].

Yelverton. C., *et al.* (2019) conducted a study entitled "Manual therapy interventions in the treatment of plantar fasciitis". This

study included 45 participants and randomly allocated into three group, each group (15 members). Treatment protocol for group 1 is mobilization and manipulation of ankle and foot with cross friction of plantar fascia, for group 2 is stretching of Gastro soleus complex and cross friction of the plantar fascia and each participants stretch for 30 sec, 3 times a day for 3 week and for group 3 is combination of three protocol which includes mobilization and manipulation of the foot and ankle, stretching of the gastro soleus complex and cross friction of the plantar fascia. Treatment protocol for all participants over the period of 3 weeks. The inclusion criteria was the ages of 18 and 50 years, Duration of pain had to be 6 weeks or more categorizing it into the chronic phase , Pain will be well localized to the medial calcaneal tuberosity, present with heel pain worse in the morning upon contact with the ground and reducing as walking progresses. The exclusion criteria were a history of hip, knee, foot or ankle surgery or stress fractures of the calcaneus, received manual therapy, cortisone injection or used anti-inflammatory medication 3 weeks prior to or during the study. The outcomes measured used were pain Algometer, Goniometer, short-form Mc Gill pain questionnaire, foot fundamental index. From this study they concluded that all the treatment has positive but the combination of stretching and manipulation is more effective [1].

Suthasine Thong-on., *et al.* (2019) conducted a study entitled "Effects of strengthening and stretching exercise on the Temporospacial gait parameters in patients with plantar Fasciitis". A double blind, randomized control trials included 84 participants and randomly allocated into two groups. Treatment protocol for strengthening group (n=42) which includes toe flexor exercise/ankle inverter exercise/ankle everted exercise/high load training 2 times per week for the first 4 week and 3 times per day for 12 weeks. Treatment protocol for stretching group (n=42) which includes Gastrocnemius muscle/soleus muscle/plantar Fascia 2 times per day for the first 4 week and 3 times per day for 12 weeks. The inclusion criteria were history of heel pain more than 1 month, heel pain during the first few steps in the morning, pain and tenderness on palpation at the medial tubercle of calcaneus, thickness of plantar fascia more than 4.0 mm on portable ultrasound imaging. The exclusion criteria were history of back and lower limb surgery, fracture or trauma, leg length discrepancy, corticosteroid injection within 6 months. The outcome measure used were VAS scale, 3 M force distribution platform, SC-1SYNCCAM. The study concluded

that both strengthening and stretching programs significantly reduced pain and improved gait in patients with plantar Fasciitis [2].

Hemlata Nirajkumar, Sharma P, *et al.* (2019) did a study on "Comparison of the effectiveness of Myofascial release technique and stretching exercise on plantar fasciitis". An experimental study selected 30 participants and randomly assigned into Group A and Group B. Treatment protocol for Group A is MFR therapy and exercises for plantar fascia which includes 10 second MFR technique applied by knuckle on sole 2 times/week for 4 weeks and Group B is static stretching and exercise of the plantar fascia, hold for 30 seconds with 5 repetition 3 sets for 30 second per session per week. The inclusion criteria included both male and female between age groups 20-50 years, pain more than 3 months over the heel, pain with first steps upon walking and that is worse in the morning during initial steps. The exclusion criteria was who were undergoing corticosteroids injection, receiving plantar non-steroidal anti-inflammatory medications within the previous 3-week, lower extremity injuries during the previous 6 months. The outcome measured used was foot function index questionnaire and VAS scale. This study concluded that MFR is better than stretching exercise in 4 weeks intervention patients with plantar fasciitis [17].

Farooq N., *et al.* (2019) did study on "Effectiveness of transverse friction massage of flexor digitorum brevis and calf muscle stretching in plantar fasciitis". A Randomized control trial conducted on 30 participants and randomly allocated to group 1 (control) that includes patients having treatment with calf muscle tendon unit (CMU) stretching exercises and group 2 (experimental) includes patients undergoing treatment with transverse friction massage of flexor digitorum brevis (FDB). The inclusion criterion included both males and females with age range of 25 - 45 years, referred from orthopedic department with diagnosed plantar fasciitis, complain of pain on the first step after getting out of bed and pain at plantar surface of mid foot. History of ankle and foot fracture or surgery in previous 6 months, bilateral heel pain and pregnant ladies suffering from plantar fasciitis were excluded from the study. Foot function index scale used as outcome measured. Between the groups comparison shown by independent t test and within group comparison was analyzed by repeated measures ANOVA. The study concluded that Transverse friction massage of Flexor digitorum brevis and Calf muscle stretching are equally effective in treating plantar fasciitis [18].

Engkananuwat P., *et al.* (2017) did a study on "Effectiveness of passive stretching of the Achilles tendon with the continuous passive stretching (CPS) instrument in patients with plantar heel pain". Fifteen subjects aged 40 - 60 years with a history of plantar heel pain longer than 1 month were included in this study. They were instructed to use CPS instrument for 5 days per week for 4 consecutive weeks. Outcome measured used are pressure pain threshold, foot and ankle disability, passive ankle range of motion, and global perceived effect were taken before and after 4 weeks of treatment. Conclusion-The results of this study indicate that the passive stretching of the Achilles tendon with the CPS instrument is effective intervention for alleviating pain and improving foot and ankle disability in subjects with plantar heel pain [19].

Khan., *et al.* (2014) did a study entitled "Role of Tissue Specific Plantar Fascia Stretching Exercises Versus Myofascial Released Technique in Chronic Plantar Fasciitis". A randomized control trials conducted on 50 participants was enrolled through convenience sampling and was randomly assigned into Stretching Exercise groups and Myofascial Release Technique groups. The treatment protocol for stretching group is stretching of plantar fascia with 30-second hold with 15 seconds rest in between each stretch with 6 repetitions per session. The treatment protocol for MFR group is Sustained gentle pressure was held for 90 seconds followed by 60 seconds and was repeated by 15 minutes. This study included patients having heel pain when first stand on his or her feet after rest or prolong walking, history of heel pain for at least last six months and pain elicited on palpation of antero-medial aspect of the calcaneum. Patients were excluded if they reported any infective conditions of foot, tumor, calcaneal fracture, metal implant, history of systemic disease, skin disease, history of any major trauma or surgery in and around ankle joint and foot, impaired circulation to lower extremities, neurological disorders, foot deformities, arthritis and corticosteroid injections in heel preceding 3 months. The outcome measured used were Visual Analogue Scale (VAS) and foot function index (FFI). The study concluded that the tissue-specific plantar fascia-stretching method as the key component of treatment for chronic plantar fasciitis [5].

Sarkar B., *et al.* (2018) done a study entitled "Efficacy of Muscle Energy Technique as Compared to Myofascial Trigger Point Release in chronic plantar fasciitis". A double blind randomized clinical trial selected 45 participants randomly allocated into Group A (MET),

Group B (MTrP Release) and Group C (control). Group-A received 12 sessions of MET along with self-stretching, Group-B received 12 sessions of MTrP release along with self-stretching and Group-C received 12 sessions of self-stretching program for 4 weeks. Self-stretching of calf and plantar fascia were given as supervised, as well as home exercise program for all three groups. Inclusion criteria's were plantar heel pain with first few steps upon walking (3 to 7cm on a 10 cm VAS scale), Pain located at the heel or plantar surface of foot consistent with plantar fasciitis, with at least one identifiable MTrP within the calf muscle and with Body Mass Index - 18 to 29.9. Following exclusion criteria's were set - Red flags to manual therapy (i.e. tumor, rheumatoid arthritis, osteoporosis, severe vascular disease, etc.), previous surgery of foot and ankle complex, any treatment for plantar fasciitis in the previous four weeks, history of foot and ankle trauma/fracture in last six months, deformity of foot and ankle complex and subjects with referred pain due to sciatica and other neurological disorder. The outcome measure used were VAS, PPT at MTrP of calf (PPT-Calf) and at medial calcaneal tubercle of heel (PPT-Heel) and functional status was evaluated by FFI scale at base line and at the end of fourth weeks. The study showed that Muscle Energy Technique and Myofascial Trigger Point release along with stretching exercises are effective in reducing pain, improving pressure tolerance and improving function in patients with chronic plantar fasciitis [20].

Shrestha S., *et al.* (2014) did a "comparative study of functional outcome between plantar fascia stretching and Achilles tendon stretching exercises in chronic plantar fasciitis". The Experimental study included 40 participants and randomly allocated Group A and Group B. Group A received instruction for plantar fascia stretching method whereas Group B received instruction for Achilles tendon stretching method. Both the groups were instructed to hold each stretch for a count of twenty and to repeat it twenty times, 2 times/day. The inclusion criteria included both gender above 16 years whose symptoms persisted for at least ten months duration, with maximum pain upon palpation of the origin of plantar fascia on the medial calcaneal tubercle. The exclusion criteria were patient with Diabetes, Gout, Connective tissue disorder, Calcaneal fracture, prior heel surgery and heel pain that were not consistent with chronic plantar fasciitis. The outcome measured used was foot function index. The study concluded that a treatment method of non-weight-bearing stretching exercises specific to plantar fascia is superior to the conventional method of weight-bearing Achilles

tendon-stretching exercises for treating patients with chronic plantar fasciitis [21].

Vinod babu K., *et al.* (2014) did a research study on "Effectiveness of instrumental assisted soft tissue mobilization technique with static stretching in subjects with plantar fasciitis". The Experimental study included 40 participants and assigned into study group and control group, 20 in each groups. Control group received only conventional exercises while study group received conventional exercises, instrumental assisted soft tissue mobilization, and static stretching exercises to triceps surae, gastrocnemius and soleus muscles. The inclusion criteria was both male and female subjects, unilateral chronic plantar fasciitis with symptoms more than 6 weeks of duration which was clinically diagnosed, ankle dorsiflexion range of motion on the affected foot was reduced, maximal pain mainly at the antero-medial aspect of the plantar surface of the calcaneus, pain that is worse in the morning during the initial steps, but which is decreases after walking continue. Subjects were excluded with impaired circulation to lower extremities, referred pain due to sciatica, neurological disorders, and Rheumatoid arthritis, taken corticosteroids injection to heel preceding 3 months. The outcomes measures used were foot function index, Goniometer for ankle ROM, pain rating scale. The study concluded that Instrumental assisted soft tissue mobilization technique combined with static stretching of triceps surae muscle is significantly effective than conventional exercises on reducing pain, improving ankle dorsiflexion range of motion and functional disability for subjects with chronic Plantar Fasciitis [9].

Komal Razzaq., *et al.* (2021) did a research study on A comparative study to analyze the effect of planter fascia stretch and heel pad with moist heat in the patients of planter fasciitis. A quasi experimental study include 80 participant and assigned into two group (A&B), 40 in each group by convenient sampling. Group A received treatment as planter fascia stretch and group B received treatment as heel pad with moist heat. Treatment was given to both groups for 4 days per week and study duration was 3 months. The inclusion criteria were included both male and female between age group 20-40 year with moderate to server condition with minimum duration of 4 week and exclusion criteria was history of steroid injections or any History of surgery in affected lower limb and if there is Any other pathology that can cause pain in heal patients having any psychological dysfunction. The outcome measured

used was foot function index and FADI. The study concluded that a treatment of Planter fascia stretching exercises has most significant improvement than followed by treatment with heel pad and moist heat [22].

Conclusion

From the result of the above review of literature, it can be concluded that therapeutic stretching exercise reduce pain and improve functional outcome.

Author Contributions

Shilpi Pal, Syeda Khanam. P and Priyali Priyadarsini contributed to the editing of the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential.

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